Current U.S. Practices in Mine Protection

United States Army RDE Command
Tank-automotive & Armaments Research, Development & Engineering Center

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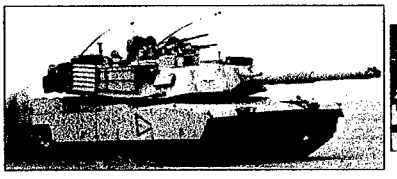
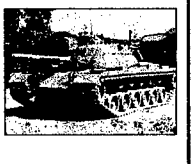
Current U.S. Practices in Mine Protection

This brief will consider logistic and light armored vehicles since medium and heavy combat vehicles are more easily able to have mine protection due to their massive structure...





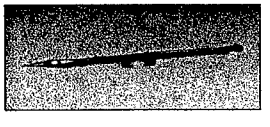
Mine protection is a minor but important part of their original design. It is not particularly efficient or interesting, but it is there...

Current U.S. Practices in Mine Protection

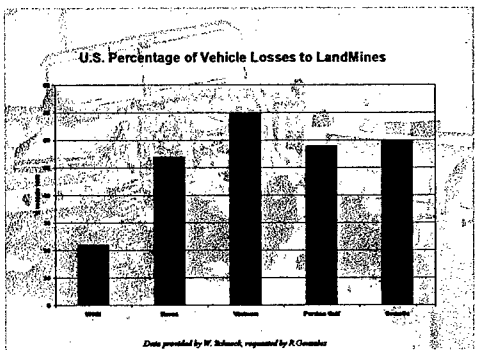
This brief only considers protection of the occupant from mine effects. Protection of vehicle function or reparability in not a high priority.

Current U.S. Practices in Mine Protection

- Mines are only one part of the threat to U.S. vehicle occupants.
- In well designed systems mine protection is integrated into a comprehensive protection package.



Mine Threat to Vehicles is Real



Data provided by W. Schenck, requested by R.Gonzalez

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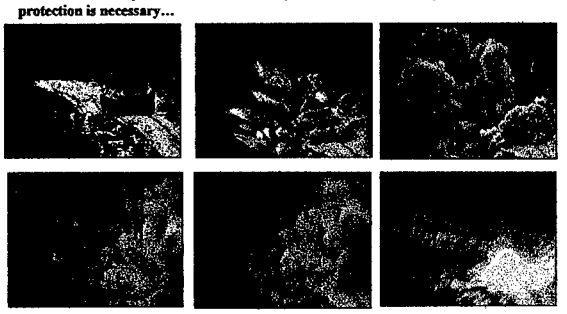
Current U.S. Practices in Mine Protection

Before discussion protection it is best to say a few words about why mine protection is necessary...



Russian BTR 8x8 armored car strikes improvised command detonated mine, machine gun turret has been blown off, all tires shredded and the entire 15-ton vehicle lifted up into the air.

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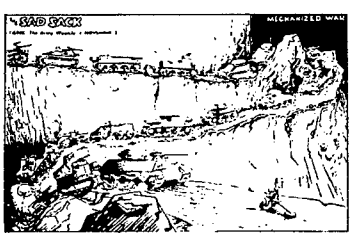
Current U.S. Practices in Mine Protection

Why not obviate the need for mine protection by knowing where the mines are and avoiding them?



- The rate of movement allowed by detectors is far too slow for conventional maneuver warfare, and it will neutralize the agility advantage upon which the Objective Force is dependent.
- Detection can usually be defeated by small changes in enemy tactics
- The resources required to secure all transit areas after sweeping are far in excess of those available to the Objective Force. If an area is not secured, it must be re-swept.

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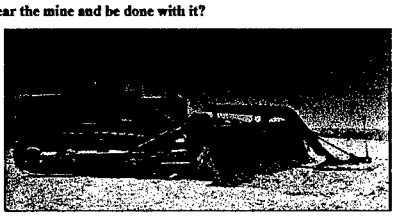
Current U.S. Practices in Mine Protection

Why not clear the mine and be done with it?



- The rate of movement afforded by mine neutralization (such as plows, rollers and flails) is too slow for the agility-dependent Objective Force
- Plows are great for breaching operations but not generally suitable for clearing logistic routes since trucks have limited mobility on disturbed soil
- Rollers are truck-route friendly but are not as dependable as one might expect
- Clearance vehicles are vulnerable to enemy mine employment tactics which specifically target them
- Electronic neutralization techniques can be expected to be effective only briefly, since the enemy is expected to have an effective communication network, they can be expected to compensate
- The energy/fuel requirements of neutralization are severe for a light force
- The resources required to secure all transit areas after clearance are far in excess of those available to the Objective Force. If an area is not secured it must be re-cleared.

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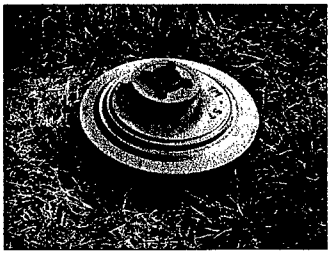
Current U.S. Practices in Mine Protection

Why not outsmart the mine fuse using low ground pressure and electronic devices?

For every attempt to finesse the threat, there is a tactical counter, usually at a very small cost to the enemy…



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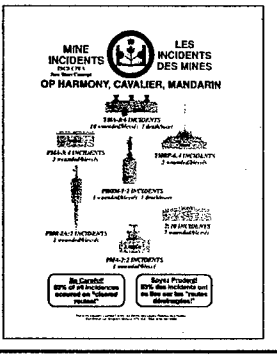
Current U.S. Practices in Mine Protection

Despite the considerable effectiveness of detection and neutralization, there is no substitute yet for the confidence that well designed mine protection gives



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Current U.S. Practices in Mine Protection

Mine survivability in the U.S. has progressed steadily for the last decade, with the result that trucks employing recent mine protection technology are sometimes more survivable than light combat vehicles of the previous generation…

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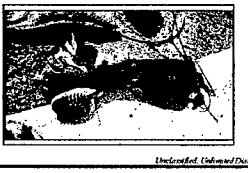
Current U.S. Practices in Mine Protection

As the U.S. focus is on the protection of personnel, rather than the protection of the vehicle, the protective measures will be discussed within the context of the traditional occupant injury mechanisms…



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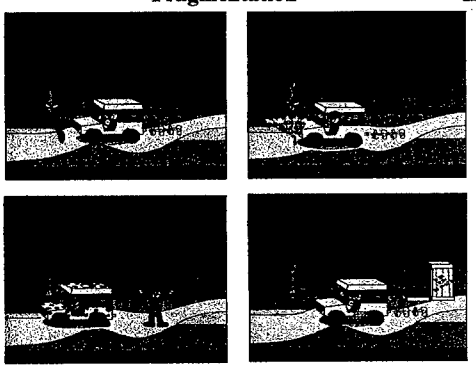
Current U.S. Practices in Mine Protection Fragmentation



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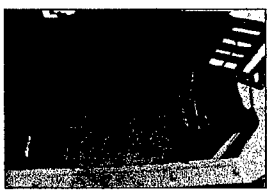
Current U.S. Practices in Mine Protection Fragmentation

Fragments – all fragments are kept out with ballistic material such as this armor aluminum floor plate.



Floor armor during M-939 Kit development

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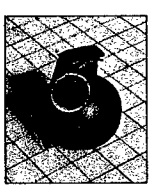
Current U.S. Practices in Mine Protection Fragmentation

Fragments – alternatively ballistic blankets are employed on the floor for grenade-class fragment threat



"Ballistic Protection Blanket" – employed on the floor, seats, and firewall

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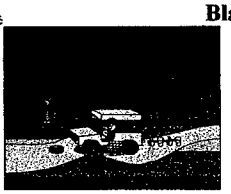
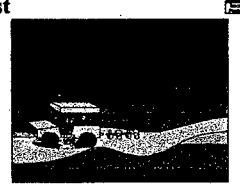
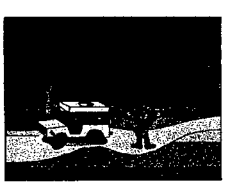
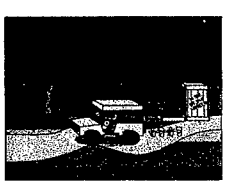
Current U.S. Practices in Mine Protection Blast









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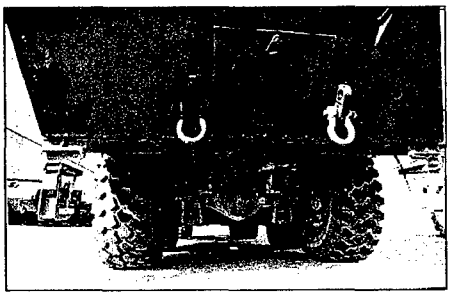
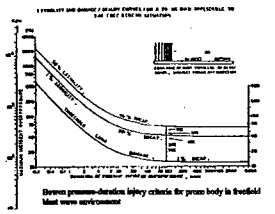
Current U.S. Practices in Mine Protection
Blast

Blast- Keep out blast with armor panels

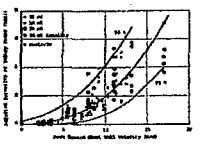


Current U.S. Practices in Mine Protection
Blast

- **Blast injury to ears is considered to occur at 2+ psi overpressure.**
- **U.S. Army does not consider eardrum rupture itself to be incapacitating.**
- **U.S. Army considers Bowen's threshold for lung damage as injury tolerance.**
- **There are several instances where ear damage is the principal injury to occupants and sometimes occupants of adjacent vehicles.**
- **NATO is considering recommendation of some type of hearing protection in logistic vehicles.**

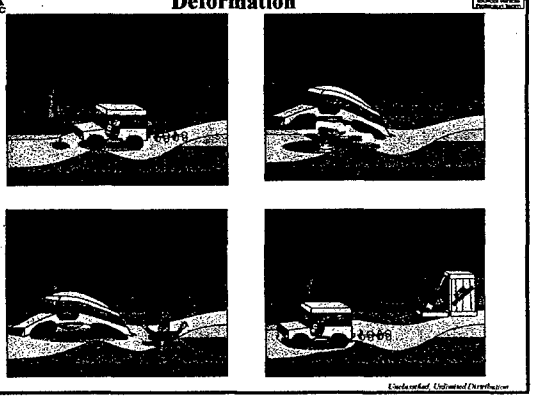


Bowen pressure-duration injury criteria for prone body in freefield blast wave environment



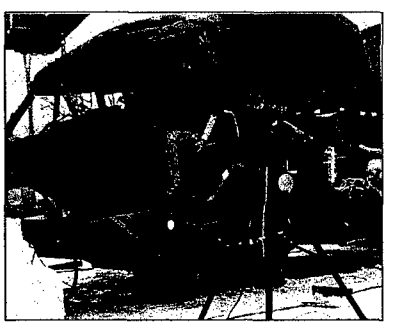
Alternative predictive methodology by Axelsson et al (Sweden) using chest wall velocity as predictor of non-auditory blast injury in complex wave environment

Current U.S. Practices in Mine Protection
Deformation



Current U.S. Practices in Mine Protection
Deformation

Deformation – Prevention of deformation is approached in two ways blast shield and blast deflectors…

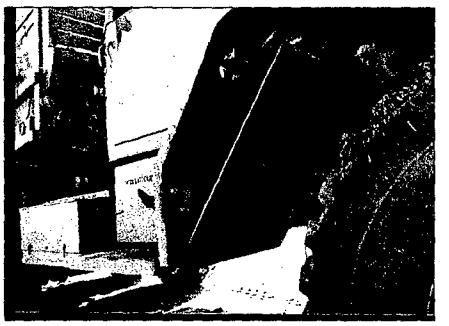


Current U.S. Practices in Mine Protection Deformation

Blast Shields- rigid plates and structures that resist deformation by their strength…

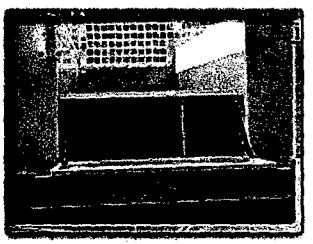
Current U.S. Practices in Mine Protection Deformation

Blast Deflectors- structures that are not required to be rigid, and deform while deflecting gasses away from the occupants…

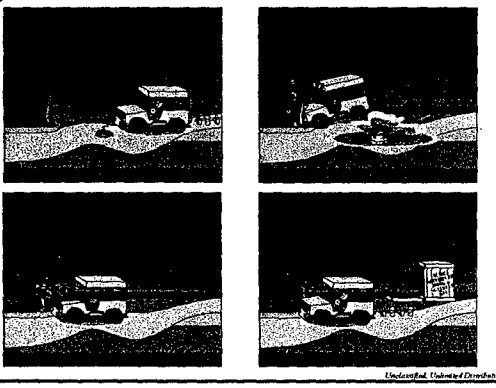


Current U.S. Practices in Mine Protection

Both approaches usually employ a secondary enclosure such as a false floor to prevent the occupant from coming in contact with the rapidly deforming plate.

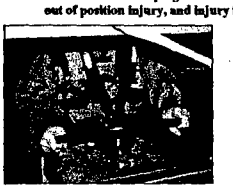


Current U.S. Practices in Mine Protection Loss of Vehicle Control



Current U.S. Practices in Mine Protection
Loss of Vehicle Control

Loss of control- keeping all vehicle occupants in restraints greatly reduces out of position injury, and injury from being ejected from the vehicle.

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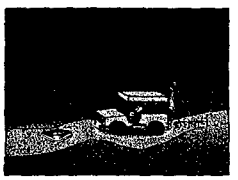
Current U.S. Practices in Mine Protection
Gross Vehicle Movement

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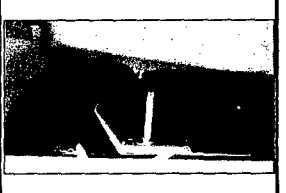
Current U.S. Practices in Mine Protection
Gross Vehicle Movement

First Generation mine protective seating limits the loads transmitted to the seat occupant (using material that deforms when stressed beyond an engineering limit.)

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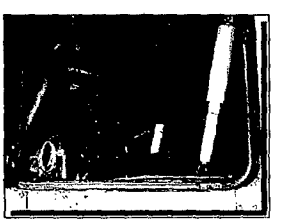
Current U.S. Practices in Mine Protection
Gross Vehicle Movement

Second Generation mine protective seating limits the acceleration that the occupant experiences by exerting a resistive force proportional to the input velocity. This seating also recovers from the blast induced compression quickly enough to function a second time when the vehicle hits the ground.

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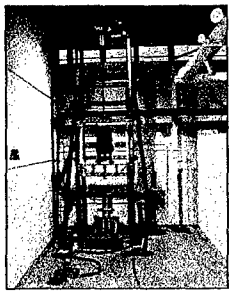
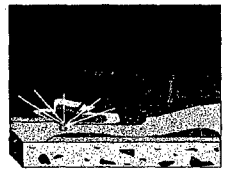
Current U.S. Practices in Mine Protection
Gross Vehicle Movement

Third Generation mine protective seating is under development…

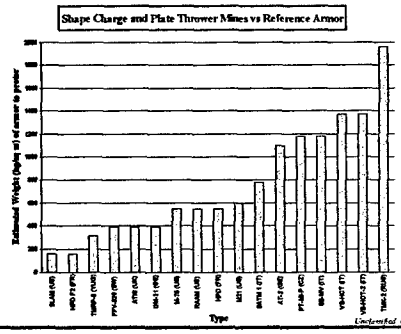


Current U.S. Practices in Mine Protection
Shaped Charges



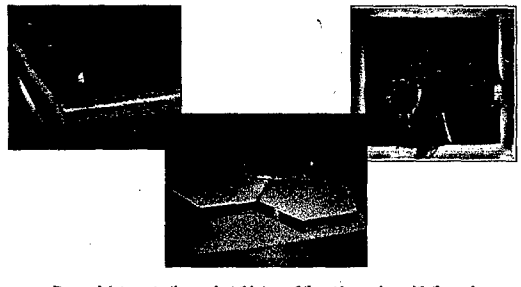
Current U.S. Practices in Mine Protection
Shaped Charges

Shaped Charges- Protection against shaped charges requires armor of substantial weight.



Current U.S. Practices in Mine Protection
Shaped Charges

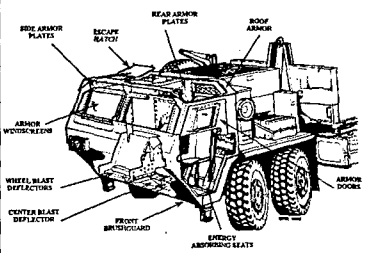
Shaped Charges- Specialized armor materials can significantly reduce the weight of shape charge/explosively formed penetrated protection.



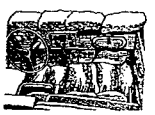
Research into protection against this type of threat is ongoing, with the goal of greatly reducing the weight of protection.

Current U.S. Practices in Mine Protection Summary

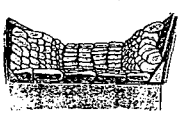
The U.S. possesses technology for mine protection and have fielded effective MP systems for support vehicles.



However, we also regularly employ more traditional mine protection techniques.



Proper Placement of Sandbags in the Cab.



Sandbagged 5-Ton M923 Cargo Truck.

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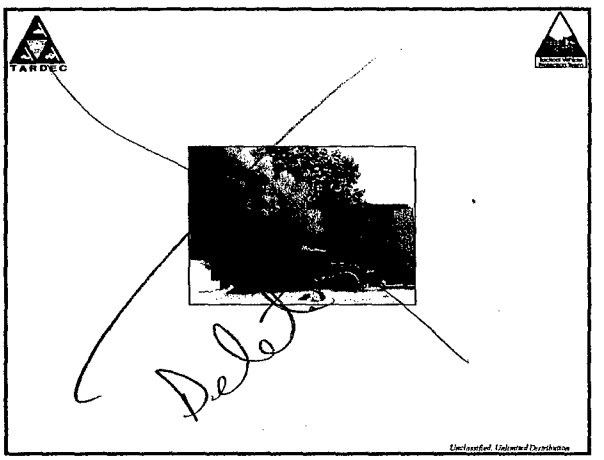

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OPSEC REVIEW CERTIFICATION
(AR 530-1, Operations Security)

I am aware that there is foreign intelligence interest in open source publications. I have sufficient technical expertise in the subject matter of this paper to make a determination that the net benefit of this public release outweighs any potential damage.

Reviewer Name: Gregory J. Wolfe Grade: GS-13
Title: General Engineer
Signature: Date: 8 Sept 2003

Description of Information Reviewed: Presentation for Sypmosium on Landmine Survivability in South Africa, September 2003. Information general in nature, non-vehicle system specific. Details general design considerations.

Title: Current U.S. Practices in Mine Protection

Author/Originator(s): Rene Gonzalez / Gregory Wolfe

Publication/Presentation/Release Date: 12 September 2003

Purpose of Release: Presentation at Unclassified Open Distribution Symposium

x An abstract, summary, or copy of the information reviewed is available for review.

Reviewer's Determination:

☒1. Unclassified Unlimited

☐2. Unclassified Limited, Dissemination Restrictions IAW

☐3. Classified. Cannot be released, and requires classification and control at the level of

Security Office ( ):

Concur/Nonconcur Signature: **Date:** 8 Sep 03

Public Affairs Office ( ):

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Margot Compton Sep 10, 2003

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